I. L. DUNN.

PROCESS AND APPARATUS FOR INCREASING THE PRODUCTION OF OIL WELLS.

APPLICATION FILED MAY 13, 1916.

1,252,557. Patented Jan. 8, 1918.

Fig. 1.

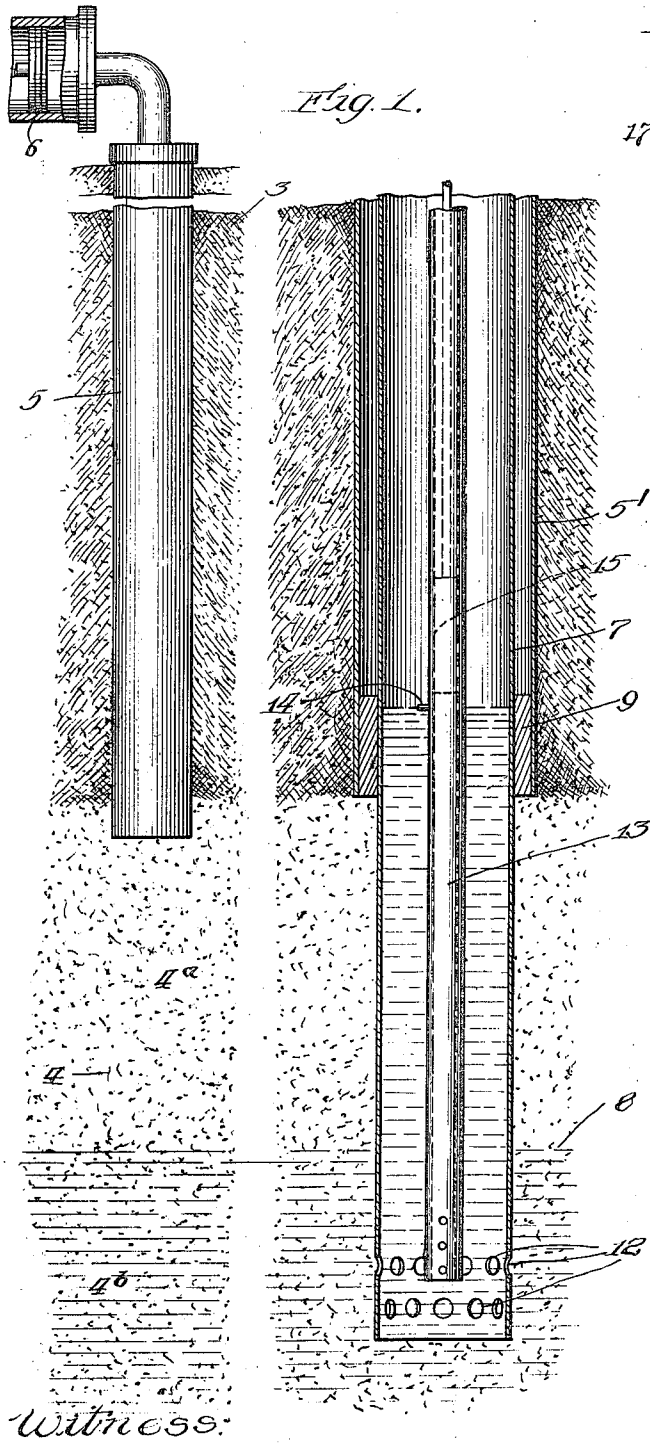
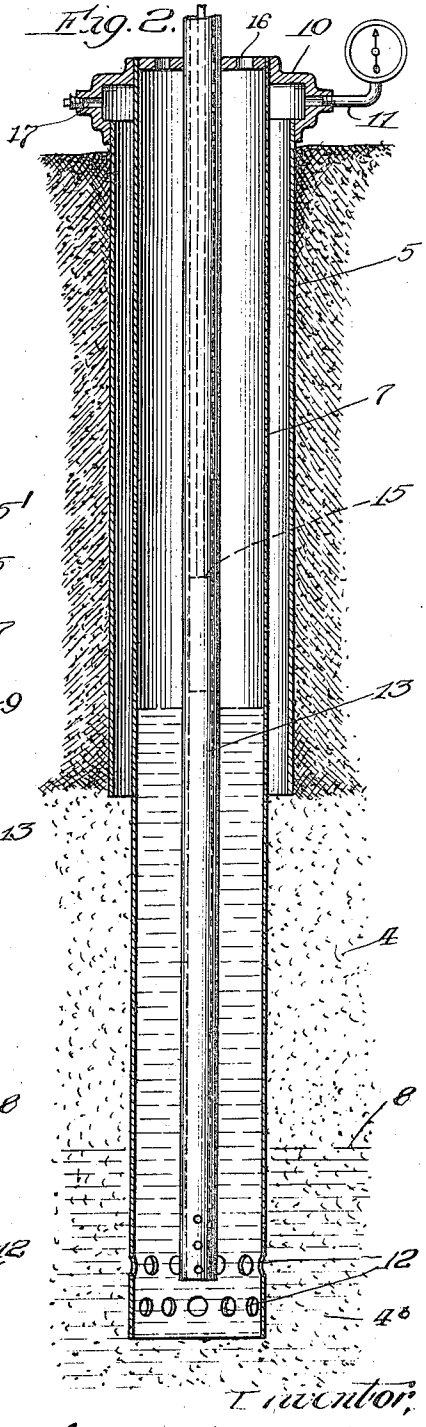


Fig. 2.



Witness:

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UNITED STATES PATENT OFFICE.

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PROCESS AND APPARATUS FOR INCREASING THE PRODUCTION OF OIL-WELLS.

1,252,557. Specification of Letters Patent. Patented Jan. 8, 1918.

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To all whom it may concern:

Be it known that I, IRWIN L. DUNN, a citizen of the United States, residing at Marietta, in the county of Washington and State of Ohio, have invented certain new and useful Improvements in Processes and Apparatus for Increasing the Production of Oil-Wells, of which the following is a specification.

Considerable areas of oil territory exist at the present time which have been drilled with numerous oil wells, the production of which has fallen off to such a point that the operation of the wells is of little profit and in many cases the wells have been abandoned altogether. It has been proposed to increase the production of such oil territories by utilizing one of the wells thereon for forcing in to the oil rock a supply of compressed air, compressors being connected to such well for this purpose, the other wells being retained in their usual condition and pumped by the apparatus ordinarily employed for that purpose. This process has actually been put into extensive use and in the majority of cases has met with a considerable measure of success. In some localities, however, the air forced into the rock instead of penetrating the full depth and thickness thereof, and so extracting the oil from the pores of the rock and forcing it to the pump of the wells finds an easier course through the upper layers of the rock probably because such layers contain no oil or follows the more porous open portions of the sand and escapes from the pumping wells without fully performing its mission. It is one of the objects of the present invention to overcome this difficulty by forcing the air to penetrate the lower layers and finer, less pervious portions of the oil sand before it can be released at the pumping wells.

It is a further purpose of the invention to automatically maintain a predetermined back pressure upon the oil and air in the rock which further assists in causing the air to penetrate throughout the sand, the denser and therefore less pervious portions as well as the coarser and more penetrable portions thereof, whereby the oil is more completely exhausted. The advantages of my improvement, however, are not confined to the use of artificial pressure, but extend also to wells or groups of wells in areas in which the natural pressure is sufficiently great without the creation of artificial pressure.

The accompanying drawing shows diagrammatically a preferred means for carrying out my invention, Figure 1 representing a vertical section of an oil region equipped with apparatus for practising my invention, and Fig. 2 a modification of one of the details thereof. Referring first to Fig. 1 I have shown therein diagrammatically two wells, both of which penetrate through the overlying layers 3 to the oil bearing rock 4, the upper part of which latter 4^a is indicated as devoid of oil, and the lower part 4^b containing oil. To the casing 5 of the well, at which the air or other gas under pressure is to be introduced is connected an air compressor pump shown diagrammatically at 6, by means of which air may be continuously forced or driven into the oil sand below. Into the casing 5′ of the second well shown is introduced a pipe 7 of somewhat smaller diameter which extends nearly or quite to the bottom of the oil bearing stratum, or at any rate well below the surface of the oil therein indicated at 8. The space between the casing and tubing is suitably closed or packed preferably, where the well is a deep well, at or near the junction of the overlying rock and oil rock as at 9, though in case the well is a shallow well the space may be closed at the top by the annular chamber 10 shown in Fig. 2, which may be provided with a pressure gage 11. The lower end of the tubing 7 may be simply left open, or perforated as at 12, and within the tubing is arranged the pump tube 13, which may be of any well known or suitable character, though preferably I place the working barrel 15 thereof at a considerable distance above the bottom of the well as shown.

In the drawing for the sake of clearness the tubing 7 is shown as of a considerably larger diameter than the pump tube 13, but ordinarily the diameter will be much less than shown so that the capacity of the annular space between the tubes will be relatively small per linear foot. The location of the working barrel in the pump with refer-

ence to the bottom of the well varies according to the particular conditions to be met, and the back pressure which it is desired to maintain. Obviously the height of the column of oil in the tubing 7 will depend upon the pressure in the rock whether natural or artificial, in view of the fact that the tube 7 extends beneath the surface of the oil. Ordinarily I prefer to locate the working barrel of the pump a number of feet below the point to which the column of oil will rise under the rock pressure, but still a considerable distance above the bottom of the well, and provide a flood nipple 14 just below the working barrel by reason of which, when the oil has been exhausted to said nipple, no more oil is raised by the pump until additional supplies have flowed into the tube 7. Thus there is always a back pressure automatically maintained by the column of oil in the tube 7, the limits of which back pressure are determined by the location of the flood nipple and the rock pressure. Thus if, for example, the rock pressure amounts to ten pounds, it is capable of sustaining a column of oil in the well approximately twenty feet above the oil level in the rock, and preferably the working barrel and the flood nipple are located five or six feet below this height, or fourteen or fifteen feet above the oil level in the well. The column of oil in the tube 7 therefore varies between fourteen or fifteen feet when the well has just been pumped, and twenty feet when the pump has been at rest for some time, and the back pressure varies correspondingly. As the oil carries with it into the tube 7, even where the level of the oil in the rock is not reduced to that of the lower end of the tube 7, a not inconsiderable quantity of gas, in order to avoid the accumulation of gas in the upper part of the tube 7, which would increase the back pressure perhaps to an undesirable extent, openings 16 to the atmosphere are formed in the diaphragm in the upper end of the tube 7 to permit the escape of the gas. In some instances it has been found desirable to subject the oil in the rock to marked variations in pressure, that is to say, to accumulate a considerable pressure therein and then suddenly release the pressure at the well. In order to effect this operation I mount the working barrel near the bottom of the pump tube, in which location it will nearly empty the tubing 7 at each pumping, thus relieving the back pressure or reducing it to a very small amount.

From the foregoing it will be seen that the improved process and apparatus is independent of the nature of the rock pressure whether natural or artificial, and in either case conserves the rock pressure and insures its action throughout the oil stratum. This is true whether the gas containing rock is in immediate contact with the oil rock, or as is not unfrequently the case separated therefrom more or less by a comparatively impervious layer.

The tube or sleeve 7 prevents the air passing directly through the upper layers of the sand to the well and forces it to descend to the lower layers to drive the oil therefrom. If ultimately the pressure of the air rises to such a point and the oil is so far exhausted that some of the air enters the openings 12, the rock pressure is still maintained by the weight of the column of oil.

While I have shown a single pumping well, it is to be understood that a considerable number of such wells may be used in conjunction with a single air forcing apparatus, or if desired more than a single well may be employed for the introduction of air. Ordinarily, however, the process is applied to a lease or area having a number of oil wells which have been bored for operation according to the previous methods, and one of the wells is selected for the introduction of air and the others either equipped with the construction disclosed, or some of them plugged to prevent the escape of the pressure air. The equipment of the several pumping wells will ordinarily be substantially the same, but the location of the flood nipple 14 will vary according to the pressure which it is desired to maintain upon the particular well to which it is applied. Where by reason of their different distances from the point of air supply, or because of peculiarities of geological formation, certain of the wells of the group are inclined to take the air at the expense of more remote or less accessible wells, by suitably locating the working barrels and flood nipples, the relative pressures in the various wells may be so regulated that the air will be distributed evenly among them.

It is sometimes desirable and is practicable to introduce the pressure air or gas into the rock through one of the pumping wells. This may be accomplished in the well shown in Fig. 2 of the drawing by connecting up to the nipple 17 a compressor or other source of gas under pressure. The gas introduced at the nipple 17 flows downwardly between the casing 5 and tubing 7 through the open lower end of the former and enters the oil rock where it is diffused in the upper part of the rock and serves to increase the pneumatic pressure therein.

I claim:

1. A process of operating oil wells which consists in introducing compressed gas to the oil sand in which the wells are located, maintaining a column of oil in the well to be pumped to exert a back pressure upon the compressed gas, and pumping the oil from said wells.

2. Apparatus for producing oil comprising means for introducing compressed gas

into the oil sand, a well casing, a tubular member in said well casing, packed with respect thereto, and extending below the level of oil in the rock, and means for pumping the oil from said tubing.

3. Means for producing oil from oil-bearing rock, comprising means for forcing compressed gas into said rock, a well having a casing, a tube within the casing extending down into the oil sand below the oil level therein, means for preventing the escape of gas between the casing and the tubing, and an oil pump in the tubing, the working barrel of which is located a substantial distance above the oil level in the sand.

4. Means for producing oil from oil-bearing rock, comprising means for forcing compressed gas into said rock, a well having a casing, a tube within the casing extending down into the oil sand below the oil level therein, means for preventing the escape of gas between the casing and the tubing, and an oil pump in the tubing, the working barrel of which is located a substantial distance above the oil level in the sand, and a flood nipple located below the working barrel in the pump.

5. Apparatus for producing oil comprising a well casing, a tubular member in said well casing but spaced therefrom and extending downwardly beneath the surface of the oil in the oil rock and an oil pump and tube within the tubular member.

6. Apparatus for producing oil comprising a well casing, a tubular member in said well casing but spaced therefrom and extending downwardly beneath the surface of the oil in the oil rock and an oil pump within the tubular member, the working barrel of which pump is located a substantial distance above the oil in the rock.

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